BOOK REVIEW.

TRACE ELEMENT PROBLEMS IN NATURE: A Symposium. Ed. by K. H. Schütte. Published by Bot. Dept., Univ. of Cape Town. 1959. 5s.

It is now generally recognised that a supply of certain elements such as iron, manganese, copper, zinc, cobalt, molybdenum, boron and iodine, in so-called trace quantities, is essential for the proper nutrition of both plants and animals. Lack of one or more trace elements may well have a most serious effect on the yields of agricultural crops or on the health of both animals and man. Diagnosis of trace element deficiencies is, however, a matter requiring specialist knowledge and without such diagnosis little can be done to remedy the existing position. From such little information as is at present available it would seem that some type of trace element deficiency is of widespread occurrence, both throughout Africa and in most other parts of the world. The diagnosis and subsequent rectification of trace element deficiencies is thus probably one of the most important problems facing organised agriculture to-day. The publication by the University of Cape Town of the proceedings of a symposium on "trace element problems in nature", held in the Botany Department in May, 1958, will accordingly serve a most valuable purpose in assisting in the wider dissemination of up-to-date scientific information on this subject.

In the first paper Dr. K. H. Schütte, of the Botany Department, University of Cape Town, gives a general review of the subject and indicates the complexity of the problems which need to be solved. These are immense, since a very wide range of factors may interact to produce conditions under which one or more essential trace elements become unavailable. To take one of the simplest and easiest cases first: the increasing use of chemically purer "artificial" fertilisers has often had the effect of cutting down the supply of trace elements which were formerly present as impurities. That these impurities may well have been of the greatest nutritional importance can be gauged from tea cultivation practices in Ceylon, where phosphate is normally supplied in the form of ground natural rock phosphate. When applied at the recommended rate, the impurities present in the natural rock phosphate have been found to be capable of supplying all the crop's requirements of zinc, copper and manganese, as well as half of its magnesium requirements.

Apart from difficulties arising out of variations in the availabilities of the different trace elements in the soil, there are also considerable difficulties in correctly assessing the optimal requirements of different crops for particular elements. These difficulties arise from variations in the individual plant's rate of growth, and therefore requirements of a particular nutrient element, in response to seasonal, climatic and other environmental factors. Furthermore, sampling and analysis of only part of a plant, which in fruit farming may be a large tree, may often give an incorrect picture due to the mobility of some of these trace elements within the plant itself. Thus a small stunted plant may easily be suffering from a deficiency of a certain element and yet show a higher percentage content of that element than a larger more vigorously growing plant. However, the latter would almost certainly show a greater total content of the element concerned.

Similarly, different crops differ in their requirements of as well as in their abilities to obtain particular trace elements from different soils, so that one type of crop may grow well on a soil which will induce marked deficiency in another type of crop.

In the second paper Dr. S. S. Amdurer, of the Geology Department, University of Cape Town, discusses some of the factors affecting the occurrence and availability of trace elements in different soils. A point of great interest brought out in this paper is the marked similarity in both physical and chemical behaviour of the five important micronutrients: manganese, zinc, copper, cobalt and molybdenum. All these elements have ionic radii of similar magnitude and all have a strong affinity for sulphur, with which they readily form sulphides. Due to these similarities all five elements tend to have much the same type of distribution, with the consequence that cases of multiple deficiencies, in which more than one trace element is in short supply, may be expected to be of common occurrence.

The frequency with which cases of multiple deficiency are found in nature is a telling argument against undue reliance on the use of visual symptoms in the diagnosis of trace element deficiency in crops, since the symptoms developed are usually specific to the particular case. In any event they will almost certainly not correspond to the pictures of experimentally produced single element deficiencies normally made use of by the exponents of the method of visual diagnosis. However, the use of visual symptoms for diagnostic purposes is almost invariably a case of "shutting the stable door after the horse has been stolen", since, by the time marked visual symptoms have appeared, the plant is usually so short of the deficient element or elements that it is quite unable to produce any reasonable crop during that particular season even if prompt remedial action has been taken.

The much more elegant and valuable method of diagnosis by means of plant injection, developed by Dr. W. A. Roach, and which is described by him in the third paper, is free of these drawbacks and is therefore much to be preferred. With the introduction of his plant injection methods of diagnosis, Dr. Roach, who is a world authority on trace element problems, has undoubtedly made a great practical contribution towards helping the present-day agriculturist to both diagnose and remedy his deficiency troubles in time to prevent undue loss of crop. We are indeed fortunate that Dr. Roach is at present working with the Winter Rainfall Region of the Department of Agriculture at Stellenbosch, and it is to be hoped that South Africa will continue to be assured of Dr. Roach's specialist knowledge and wide experience for many years to come.

It would be presumptuous to comment on this most valuable contribution to the symposium. However, it should be noted that many of the South African deficiency cases investigated by Dr. Roach were found to be cases of complex multiple deficiencies of several trace elements, which would have proved difficult or impossible to diagnose correctly except by means of his plant injection technique.

The final paper, by Professor J. F. Brock, of the Department of Medicine, University of Cape Town, deals with the role played by trace elements in mammalian physiology and pathology. Of particular interest is his description of the recent research, which has successfully demonstrated the essentiality of selenium in the diet of experimental rats and chicks. The search for the particular factor required to eliminate the deficiency symptoms concerned was involved and difficult, since it was long and erroneously thought that the wanted factor was organic in nature as it was either lost or destroyed on dry ashing the protective diet. Boron, like selenium, is another trace element which is lost on dry ashing, and it is probably because of the analytical difficulties involved that even now still only comparatively little is known of the role of boron in plant and animal nutrition. It is to be hoped that this selenium work may stimulate further investigations into the functions and behaviour of boron.

As well as directly affecting nutrition, trace elements may also indirectly influence diet, since a deficiency or excess of certain trace elements may render a particular foodstuff unpalatable or otherwise unfit for consumption. Thus manganese-deficient potatoes, whilst apparently otherwise normal, may develop a most unpleasant flavour. Similarly, tea leaves containing less than about 15 p.p.m. of copper do not produce enough of their characteristic copper-containing polyphenol oxidase enzyme to permit of proper fermentation during the course of manufacture and are thus unsuitable for ordinary black tea production. This is a curious case, since the enzyme concerned does not appear to play any major part in normal cell metabolism but is activated when the cell contents are brought into direct contact with atmospheric oxygen as a consequence of one of the processes of manufacture. In fact, tea clones with a natural copper content of under 10 p.p.m. are known which are vigorous growers and high yielders.

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